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ABSTRACT

This report examines the context and impact on the classroom of teacher and student access to the Internet in K-12 education in Saskatchewan (Canada) public schools. It begins with a description of the Internet, including funding and connectivity concerns. The following four basic services of the Internet are introduced with examples of K-12 implementations: electronic mail (e-mail); Internet Relay Chats (IRC); USENET newsgroups; and file transfer protocol (FTP). Examples of commercial, educational, and community Internet providers are presented. Next, the impact of the Internet on K-12 education is discussed and several issues are examined, including access to the Internet; acquiring the skills to navigate the Internet; technical support; navigational aids; telephone lines; increasing traffic; capability of hardware; access to material unsuitable for the classroom; finding time for using the Internet; and student assessment. Finally, five recommendations for using the Internet in Saskatchewan schools are made. A reading list for additional information is provided. (Contains 31 references.) (JLB)

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K-12 Education and The Internet

A
Technical Report
Prepared for
Saskatchewan Education,
Training and Employment

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Executive Summary

Since June, 1993, The College of Education (Saskatoon) and the Saskatoon Public School Board have been helping nearly 40 teachers from the Public School system explore the Internet, and build their network navigation skills. As a spin-off of this project, many classroom-based activities have been conducted by teachers with their students. The main purpose of the project is to determine how much support classroom teachers need to feel comfortable with the technology and once they have become comfortable with the technology, what have they been able to do with the network that is of value to them in their classrooms.

What is the significance of all this capability? What does it mean to K-12 education? These and many other questions can be amalgamated into one key question. If an information utility such as Internet becomes as commonplace as other essential utilities, what are the implications of being able to travel the electronic highways for teachers, students and school administrators in Saskatchewan schools? Access to learning resources on computer networks has the same potential to influence classroom practices as the textbook and the chalkboard did when these new technologies were introduced into the classroom. The use of networks can be a motivator for students. The use of networks encourages the kind of independence and autonomy that many educators agree is important for students to achieve in their learning process. Because the Internet is blind to class, race, ability, and disability, it is a natural for addressing the needs of all students; exactly how this is done will vary from school to school as the school empowers the individual.

The increasing volume and types of information available in electronic form, increasing resource sharing & networking ability, and increasing attention to accountability and productivity are three themes that recur frequently in the current literature. The "Information Highway" has captured the imagination of the popular media. Hardly a day goes by without mention of it somewhere. The term has been used so often, for so many purposes, that it has lost most of its meaning. It can however, be defined in terms that have already been used in this report. Most of the talk about the Information Highway centers around increasing the carrying capacity of the backbones, and widening the reach of many regional and local networks. The result will be an increase in the volume and variety of information available to most citizens.

Like computers, computer networks are tools. They are not a solutions to problems, either real or imagined, at any level of the educational system. Instead, networks make it possible for students and teachers around the world to engage in projects that change routine tasks such as writing papers and engaging in discussion into exciting, collaborative learning activities. The communications capability of the network seems to capture and maintain students' interest in academic activities. The motivational aspects of the network and its ability to help students achieve a more global understanding of issues and events make access to the network a worthwhile undertaking. There is widespread agreement that telecommunications can enhance the range and scope of what students learn in the classroom.

Introduction

We take utilities like the natural gas, telephone and electrical services for granted unless they are disrupted. While we have become quite used to using these utilities in our homes and schools, we are only beginning to see the potential benefits of having access to learning resources that are stored in repositories well beyond our school, community or university library systems.

> *"Since the invention of the telephone by Alexander Graham Bell in 1876, Canada has always considered it essential to have strong communications networks — owned and controlled by Canadians —for trade, competitiveness, cultural vitality and national sovereignty. The government has actively supported the development of such networks: the Trans-Canada Telephone System was set up in 1932, the Canadian Broadcasting Corporation (CBC) was established in 1936; transcontinental microwave networks were built in the late 1950s; the first in a series of domestic, communications satellites was launched in 1972; cellular telephone services were rolled out in the late 1980s; and fibre optic networks have been laid coast to coast over the last two years."* (Manley, 1994)

Recent technological developments in North America and throughout the world, have resulted a rapidly growing desire to link computer networks together. The Internet, a consortium of government, commercial, academic and research organizations, have agreed to share a common software protocol. A common protocol or set of software standards facilitates remote access to all of the computers connected to the network, sending and receiving electronic mail, and transferring all types of digital files. Different computers and networks may have different levels of access to the Internet. For example, many users have electronic mail access but fewer users can use the file transfer and remote access capabilities of the network.

While hardware and software requirements are important from a product point of view, it is the process or communications component that makes the Internet work. The ability to easily communicate with a community of people situated around the world is the real glue that holds the Internet together.

Internet access serves many purposes and many audiences. These audiences include government departments, corporations, universi-

ties, research centers, libraries and most recently K-12 teachers and their students. It offers great flexibility in allowing participants throughout the world to communicate with each other and to take advantage of each others' computer-based resources. However, it was not designed with computer novices in mind and it is not generally thought of as being user-friendly. Navigation among the thousands of computer hosts sites throughout the system can be a tremendously time-consuming challenge. For knowledge pioneers and explorers, like the early settlers traveled to their new homes in horse drawn wagons, the terrain is necessarily a little bit rougher.

Resource-based leaning is an accepted priority for Saskatchewan educators. Independent learning, lifelong learning and technological literacy are also integral to the Goals of Education for our province. If the current pace of technological change continues, by the end of the decade, knowledge of digital forms of learning resources, the ability to retrieve them and to incorporate them into instruction and learning will be essential skills for every teacher and learner in every classroom. For most teachers, like the adoption and use of video based learning resources, this will be an evolutionary rather than a revolutionary process.

Television was at one time a new technology. Viewers who were used to listening to radio broadcasts took little notice of the television announcer reading the sponsor's commercials while perched on a stool in front of the television camera. The approach was acceptable because neither the broadcaster nor the viewer had learned how to use the technology. Similarly, many teachers who use resource-based learning do so in a manner much analogous to the way in which television announcers read their scripts. We are in a stage of transition and just beginning to undertake the task of learning how to use network technology.

Access to learning resources on computer networks has the same potential to influence classroom practices as the textbook and the chalkboard did when these new technologies were introduced into the classroom. Issues such as how to effectively help teachers learn how to use resource-based learning and how to remove barriers to student access to the networks must be addressed soon or all we'll ever have is a few "photo-opportunity" schools while 99% of children miss out on the opportunity to learn skills that will equip them to function effectively in competitive job markets.

What is the Internet?

The Internet consists of many computer networks large and small, which are interconnected by high-speed data links, or "backbones" that use an agreed upon communications protocol. NSFNET in the US. and CA*net in Canada are the backbones of each system. In Canada, provincial networks from all 10 provinces form the second level. Local area networks or LAN's resident in the universities, government agencies and research institutions form the first level of the network.

The Internet was brought into existence about 20 years ago as a US. Defense Department research network called the ARPAnet. The result of this activity was analogous to building a provincial grid road system. It was usable in the sense that you could drive across Canada on grid roads, but the route was not very efficient when compared to the Yellow Head or Trans-Canada highway system. At about the same time as the Internet was coming into being, Ethernet local area networks (LANs) were developing. This technology quietly matured until desktop computers became commonly available in the early 1980's. With the advent of the desktop computer, users began to demand a connection to the ARPAnet instead of connecting directly to a single large time-shared computer system. This would allow all the computers on that LAN to access other networks also on the ARPAnet backbone. At about that same time, other organizations started building their own networks using the same communications protocols. If these networks could talk together, users on one network could communicate with each other and everyone would benefit (Krol, 1992).

Federal legislation authorizing the creation of the National Research and Education Network (NREN) was signed into law by President Clinton in December 1991. This network is designed to expand, enhance and eventually replace the existing US. Internet backbone. NREN will have the speed and capacity to move as much as 3 billion bits of information from coast to coast — the equivalent of shipping the contents of a large encyclopedia from New York to Los Angeles in a few seconds. That kind of speed allows for widespread distribution of video files without bogging down the entire Net (Griffin, 1993).

A key intent of this legislation was to ensure that the new information technologies created by the NREN would be available for use in factories, libraries, K-12 schools and, medical institutions. Funds would be authorized to create digital libraries, connect

primary and secondary schools to the network, and provide educational and training software (Gore, 1992). Given that library and education communities are continuing to expand their use of electronic networks, NREN has the potential to dramatically change the nature of both education and scholarship (Bishop, 1991).

In 1990 CA*net, like NSFnet in the US., was created by a consortium of research communities in Canada to help overcome the burden of dealing with network service duplication, protocol incompatibility and system overload (Cleveland, 1992). Presently, Canadian universities and research centers are connected to CA*net, which is part of the worldwide Internet. Within five years, CANARIE (CAnadian Network for the Advancement of Research, Industry, and Education) will upgrade the national backbone from 56 kilobits per second to T-1 speeds (1.544 megabits per second) and then to T-3 speeds (44.736 megabits per second). CANARIE will make full use of existing Canadian technology and the present CA*net infrastructure. Hopefully, this strategy will minimize duplication of funding, efforts, and resources (Silva and Cartwright, 1992).

CANARIE advances essentially the same paradigm as the NREN. Silva and Cartwright (1992) identify five goals for CANARIE. CANARIE will: (1) promote communications technology in support of Canada's research and development community; (2) create a test bed for the development of Canadian electronic products; (3) introduce Canadians to new technologies and act as a catalyst for exploiting the new services that high- speed networks permit; (4) offer research centers, government, and private companies network-based services; and (5) promote the development of information databases and virtual libraries.

At the moment, Sask#net, the provincial network, is jointly managed by the University of Saskatchewan and University of Regina. Like comparable second level networks in other provinces it is part of the Internet through its membership and connection to CA*Net. "About seven gigabytes (billion words) per week now flow between SASK#net and CA*net. This traffic has grown 1.2% per week (100% annually) for the past two years" (Jones, 1993, p. 6)

Who pays for the network?

No one pays for Internet directly because there is no company or agency that collects fees from all the users. Instead the members of the network come together and decide how to connect themselves together and to fund these interconnections. In this way, everyone pays for their own part of the network. For example, NSF pays for NSFNET. Similarly, colleges, universities and corporations in turn pay for their own connection to a regional network, which in turn pays a national provider for their access. From an individual user's perspective, the use of telephones is analogous to the use of a computer network. Only when there is a problem does the user care which network or link in the network is being used. If something fails, it is up to the owner of the link to fix it just as each phone company is responsible for fixing its own part of the telephone system (Krol, 1992). The demand keeps growing. There are 15 million users in 100 countries already. New users are being added at the rate of about a million users per month (Carrol & Broadhead, 1994).

For an individual user or a school based group to connect to Internet, a subscription or contract with a service provider is required. A service provider is a commercial or non-commercial agency that owns or controls a computer network that is connected to the Internet network. For the most part, these service providers can be differentiated by the geographic units they serve, their educational missions, the audiences they serve, and the design and technical capabilities of their systems. For example, general purpose, commercial networks like CompuServe and America Online are the "supermarkets" of computer-based, on-line telecommunications. For a fee, they provide a full range of services such as those previously discussed.

On the other hand, regional networks like The Sask. Education BBS (Regina), The Capitol Free-Net (Ottawa, Ont.) and Big Sky Telegraph (Dillon, Montana) provide a similar range of services but the cost of these services is borne by the government or institution setting the network. Similarly, public library systems like the Saskatoon Public Library and research libraries like the University of Regina and University of Saskatchewan will offer a restricted list of services such as access to on-line card catalogs without cost to patrons.

How can I connect to the network?

A low-end service could be provided by a vendor at a cost, by a local university, or as a part of a public access service like a community freenet. A computer, terminal emulation software and a modem which is compatible with the dial-in service are all the equipment that is required. The approximate cost, not including the computer, ranges from zero to about $200.00 per month. Currently, a SASK#net dial in account costs $30 per month, $3.00 per hour after the first two hours per month, and a $100 startup fee. If dialing into the system from other than a local number, long distance charges also apply.

A mid-range dial-in service provides a Serial Line Internet Protocol (SLIP) connection or Point to Point Protocol (PPP) connection to the Internet network. Users who require higher data transmission and receiving rates can justify this type of connection. The approximate cost of this service, not including the PC, is approximately $750.00 per month.

Full, high-end service requires a subscription to a service that provides a full Internet connection. A router and a CSU/DSU (Channel Service Unit/Data Service Unit), and a device which connects the router to the service provider's router are required. A local area network, which may consist only of the router and a PC, Macintosh, or other computer system, is also needed, and the computer(s) will need some special software. The approximate cost, not including the computers, is about $2,500.00 per month.

What services are available on the network?

Four basic services are available from Internet. They are mail, chat, news groups and file transfer. In virtually every survey of Internet services, electronic mail, or e-mail is the most popular service offered by the network. The preparation, sending, and receiving of messages, documents, or images is the electronic equivalent of sending and receiving private letters. For example, KIDSPHERE is a mailing list for elementary and secondary teachers, who use it to arrange joint projects and discuss educational telecommunications. News of new software, lists of sites from which you can get computer-graphics pictures from various NASA satellites and probes and other news of interest to modem-using teachers can also be found in this list. KIDS is a spin-off of KIDSPHERE just for students who want to use the network to contact other students. KIDLINK is a another mailing list which provides a forum for "key pals" to meet, for projects ideas to be exchanged and for teachers to chat. It is a good source of contacts and information.

Another service offered is a live-text conference or chat. A conference or chat service is the equivalent of an on-line, text-based version of a telephone call. In enables users from all over the world to converse with one another, simultaneously, from their computer keyboards. Instead of voice transmission and reception like citizen's band radio technology, the conversation is read from the screen and responses are typed. This feature can be used to connect a single caller with someone who can help solve a problem or to bring a large audience in touch with a respected expert (Lavine & Baroudi, 1993). For example, KIDPROJECT is a large forum of teachers who have great ideas about projects to work on with kids. The best part of this LIST is the ability, once your subscribe to partake in IRC CHATs - live, interactive chats with students from around the US and sometimes the world. Students often prefer IRC CHATs over e-mail. While some students want to send more and more e-mail, they were often frustrated by how long it takes to get a reply. In contrast, CHATS are immediate and 100% successful.

K12 Net provides an international chat channel for students and foreign-language discussions lists in which students can practice using languages such as French with native speaking students from Quebec. There are also teacher conferences that focus on specific subjects, from physical education to physics.

A third important source of text-based educational information is the Internet's USENET news groups. News groups are a massive collection of topic-specific forums in which participants can send and receive news, debate issues, ask questions, and provide answers. For the most part, they are simple "linear" bulletin boards in which messages appear as they are posted by forum participants. Many news groups are of interest to teachers and students. Subjects range from archaeology to Zen. For example, SPACEMET is run by the physics and astronomy department at the University of Massachusetts at Amherst. Like K12, SpaceMet Forum began on Fidonet, and has recently grown much larger. Mort and Helen Sternheim, professors at the university, started SpaceMet as a one-line bulletin-board system several years ago to help bolster middle-school science education in nearby towns. Today, there is a whole series of satellite SpaceMet BBSs in western Massachusetts and SpaceMet itself is now linked to Fidonet and Internet.

NEWTON is another BBS-like system, run by the Argonne National Laboratory. It offers conferences for teachers and students, including one called "Ask a Scientist." This category lets you ask questions of scientists in fields from biology to earth science. Other categories such as teaching, sports and computer networks are also available.

Gateways are electronic doors through which a user can travel to connect to another network somewhere in the world. The ability to search on-line reference tools such as electronic encyclopedias, on-line library card catalogs, electronic book reviews, and electronic indexes removes the barrier of distance between users and the information they require. The user, having found the desired information, can use another tool called the file transfer utility or FTP. The ability to exchange documents is often referred to as uploading (sending) and downloading (receiving) files. FTP facilitates the sending and receiving of documents. Documents can consist of text (the Meech Lake Accord, for example), graphics (space probe pictures of Jupiter), sounds, speech, and video. A good source of documents to support science courses can be found on NASA's SPACELINK in Huntsville, Ala. Together with maintaining a large file library of space graphics, Spacelink contains reports and data about NASA, its history and its past and present and future missions.

When compared to the more complex services being promoted by both the cable companies and the telephone companies, the level of global communications capability described here may appear to be pretty basic . If the analogy between information utilities and other utilities is correct, then it is reasonable to expect that users will contract for and pay for information services in a manner similar to the way we contract for and pay for heat, water, electricity and telephone services. However, some Internet services analogous to public libraries will have public access areas available to everyone without direct cost to the user.

Who are the service providers?

Connection to the Internet for members of an academic community, research organization or government department is often as simple as requesting a computer account from the computing services section of their organization. Individuals who are not members of one of these institutions may elect to purchase an Internet connection from a commercial or voluntary service pro-

vider. CompuServe, a commercial service provider, reports a user community of over 900,000 on-line users. Due to its wide range of features and services, and its variety of users, CompuServe serves as a unique research community for personal educational benefit. Students using CompuServe can link with scientists, mathematicians, and other experts via the extensive forums or bulletin boards available. (Contacts made within forums can be continued on a one-to-one basis via e-mail.)

Students can access forums and a variety of databases to retrieve full text or abstracts of articles from magazines, journals, and other publications for research projects or interests. For example, students who log into CompuServe may find a main catalog with the following sub directories:

Acquired Immune Deficiency Syndrome (AIDS)
Computers
Dissertation Abstracts
Engineering
ERIC (Educational Resources Information Center)
Health
Medicine, Sports Medicine, Rare Diseases
Newspapers and News wires
PsychINFO (Psychological Abstracts)

According to current plans, each week students throughout the US. and beyond will be invited to participate in one or more on-line conferences. Each conference will feature a special guest "speaker" — a successful professional who will "talk" to the students about the challenges and rewards of his or her chosen career. Students will be able to type questions to the guest about his or her work and learn more about the profession's educational and skill requirements.

In contrast to the commercial service providers, the Montana state department of education supports The Big Sky Telegraph. This project is operated as a bulletin board system and software archive. It is accessible by over 100 one-room schools and numerous private citizens throughout rural Montana and neighboring areas. While school use dominates the system, innovative on-line training for pre-college, vocation preparation is periodically provided to individuals as well. The system also supports agricultural databases and telewriting activities related to the US. Forest Service.

Features of potential value to students include:

Community Medical Clinic
E-mail
Educational database access
Electronic newsletters
Public domain software
Science and math teaching ideas (intended for teachers but available to students and parents involved in home schooling)
Science essays, ideas and experiments
Technical and educational support
Telecommunications lessons

The complete set of offerings on Big Sky Telegraph changes over time. For example, MIT's Plasma Fusion Lab has previously delivered a high school level, chaos-theory course for gifted science students. A local Women's Center received funding for homebound women to receive technology training at their homes or places of work using loaner computers and modems. A public affairs officer for the US. Forest Service learned on-line telecommunications via Big Sky and then created an electronic conference on conservation with participation from the Forest Service, loggers, conservationists, and Earth First (an environmental activist organization).

On the other side of the coin, freenets are incorporated as a non-profit community utilities that are free to everyone in the community They will neither charge nor pay for any information or other services they provides. In essence, a freenet is an electronic community centre, public square, and information fair. Information posted on the bulletin board is provided by many community organizations, local government, and educational institutions. Membership often includes a gateway to the Internet and is usually free. The National Capital FreeNet based in Ottawa is one of the many examples of a computer-based information service designed to meet the present information needs of the people and public agencies in the region.

Cooperative freenets have been formed because of the failure of many community agencies to develop and maintain its own expensive, under-subscribed, single-service telecommunication service. Freenets make it possible for each member to be part of a single, cost effective, sophisticated, multi-line computer facility. The

FreeNet is a shared platform with each organization having a large, dedicated space on the system and autonomously determining how it is used. The costs associated with building and maintaining this community service are relatively modest. What costs there are will be covered through public and private grants donations, and other fund raising methods that have been successful in other communities.

Curriculum-based educational telecomputing is a high priority for Academy One on the US. based Cleveland Freenet. The brief list of projects that follow are applications of the core curriculum that teachers have developed for use with their students. Some of the projects use more sophisticated equipment or telecomputing skills than others, but an effort is maintained by Academy One administrators to provide a way for ALL levels of computer users to participate.

The NATIONAL EDUCATION SUPERCOMPUTING PROGRAM is a multiple grade level, on-going program that provides students with remote access to the supercomputing facilities at the Lawrence Livermore Laboratory. When coupled with the use of special simulation software at the local school, students can explore such diverse areas as: climate modeling, ray tracing, molecular configuration, and plant modeling. Teacher training, software distribution, and curriculum integration are combined with a telecommunication component that stresses collaboration and joint research to conserve resources and enable more to participate.

NETPUT TELEOLYMPICS is a "virtual Olympics for grades 1-12 and ran from March to May. Students compete in a series of track events in their own school yards and post the winning scores in each category on the computer network. The results are compared and international winners receive recognition. In addition to the track events, opening and closing ceremonies are conducted like the real Olympics, and information is exchanged about schools and communities around the world. This form of telecommunications is a great way to integrate geography, writing, math, computer science, and physical education.

FOREST DAY, a multiple grade level special event program is a project that sets aside a day to reflect on the importance of the forest. This activity includes discussions on the various types, from rain forests to kelp forests. Activities include a school-site

tree inventory, forest picture exchange, and analysis of the effect of deforestation on the earth's climate using the Lawrence Livermore supercomputer center.

LA CLASSE GLOBALE FRANCOPHONE is an on-going project for multiple grade levels in an electronic classroom designed for communications in French between young people of all ages and all countries. This area includes the news from France in French five days a week and a moderated discussions with lesson plans that change regularly.

KID TREK is an on-going project that provides a special place for those students who are science fiction writers, and an alternative for students and teachers who are interested in the space simulations, and want to participate in a literary way.

TAKE 2 is an electronic networking component to an interactive television show by kids for kids. Students combine their performing art, creative writing and problem solving skills to work on youth-related problems, such as gangs, school drop-outs, drugs and smoking, and teen pregnancy. Students are invited to submit their own videos for inclusion in the PBS series after watching the pilot show.

CURRICULUM EXCHANGE is an on-going project for educators and parents. This area will start with over 500 lesson plans on social studies, math, language arts, and science. Teachers are encouraged to share their most successful lesson plans for others to use.

The TEACHER EDUCATION CENTER is an area where teachers, teacher educators, and teachers- in-training may raise questions and discuss issues related to improving education and learning. Concerns about using technology in classrooms are addressed, as will more general issues related to the art of teaching. Questions related to Academy One and other K-12 telecommunications programs will be answered, and practical tips for new users are provided. The Center provides information about professional development opportunities, state and federal legislation, and professional organizations. It also maintains a calendar of regional and national technology conferences.

THE MIDDLE SCHOOL NETWORK is where middle school curriculum and activities programs are designed to recognize that adolescents have unique physical, intellectual, and social-emotional development. The middle school program attempts to balance the development of the student in each of these areas. Students are involved in activities to help them understand their growth in these areas, and to make short term and long term plans to capitalize on their strengths and address their shortcomings or expressed needs. In short, the middle school program is acutely aware of the need to educate the whole child.

The PARENTS ARE TEACHERS area is for those who are currently involved in home schooling or want to become more involved in their child's education. Information will be available on home schooling resources. Also, this is an area where parents can find out how they can become involved in Academy One and get their children involved in projects from home.

The INTERGENERATIONAL EXCHANGE is an on-going project for all grade levels that allows the various generations to compare how traditions, sports, music, and family roles have changed over the years. There is value in the memories of each generation and opportunities to learn through the sharing process. Here is a way for Senior Citizen groups to become involved with our youth and pass on heritage in a personal way.

LETTERS TO SANTA is a special event program that runs from November 1 to December 20. It is a popular project and involves many grade levels. Students in grades K-2 write a letter to Santa. Often, but not always, this letter is entered into the computer by students in grades 4-6 and posted to an Academy One news group, where students in grades 8-12 respond as Santa. The students in grades 4-6 receive the letters from Santa, print them on special paper, and award them during holiday programs to the youngest students. This is an example of an effort from multiple grade levels, and the sharing of a common desire to bring joy to others.

Similar types of projects and services have recently become available in Saskatchewan. For example, the Saskatoon Freenet Society has recently been formed. The plan is to model the Saskatoon Freenet on the Cleveland Freenet and the National Capital Freenet previously described. Saskatchewan Education operates a bulletin board system in Regina, which may be reached with a local tel-

ephone call in many urban areas of the province. This bulletin board service (BBS) offers E-mail conferences, lesson plans, and many other resources of interest to teachers. It does not yet offer an Internet gateway. Through Infoaccess, the University of Saskatchewan library offers on-line access to:

Catalogs of U of S Library Collections
Other Campus Collections
Saskatoon Public Library
Saskatchewan News Index
Saskatchewan Teachers' Federation Library
MURLIN (MultiUser Regina Library Info. Network)
Regina Public Library
Education Databases
Health Databases
Humanities/Social Sciences Databases
Legal Databases
Science Databases
Newspaper Databases
Subject Guides — How to find out about ...
E-Journals
Data Services
Library Catalogs Worldwide (Hytelnet)

At the present time there is no charge for services and there is no access to Internet through this system. Users bear the cost of long distance charges if such charges are applicable.

Since June, 1993, The College of Education (Saskatoon) and the Saskatoon Public School Board have been helping nearly 40 teachers from the Public School system explore the Internet, and build their network navigation skills. As a spin-off of this project, many classroom-based activities have been conducted by teachers with their students. The main purpose of the project is to determine how much support classroom teachers need to feel comfortable with the technology and once they have become comfortable with the technology, what have they been able to do with the network that is of value to them in their classrooms.

In other provinces such as B.C. and New Brunswick larger projects are under way. The Education Technology Centre of B.C. is currently piloting a province-wide educational network. This network has approximately 2,200 accounts, including teachers, administra-

tors, students, and others within the province. Through the network, subscribers have access to electronic mail, conferencing services, and information resources. Various kinds of technical support are provided by ETC to teachers who wish to learn to use the network, including training sessions within the district, an extensive manual, and a free telephone help line. In addition, within a number of school districts, teacher facilitators help novice colleagues. These facilitators receive training and on-going support from ETC (Wighton, 1991). In New Brunswick, network is being built to provide access to provincial, national and international educational resources. Networked personal computers are being installed in every K-12 school and district office in the province over the next two years (i.e. by 1996).

The federal government Department of Industry and Science Canada has established SchoolNet. The goal of this project is to connect every school in Canada to the network so that they will be able to take advantage of this new learning medium. Initially 300 schools were slated to take part in a pilot project. To date, over 600 schools are directly or indirectly members of this initiative. The objective of the project is to enhance science and technology learning opportunities by making national and international education resources available. The services provided through SchoolNet include a/an:

- user's guide to the 100 best Internet science and technology resources to support classroom learning
- training manual to assist teachers in getting connected and learning how to use the network functions
- directory of SchoolNet participants, databases of software, educational resources, research work;data worldwide Internet e-mail addresses and Internet manuals/guides
- electronic discussion groups for teachers/students
- career selection guide produced by the Minister of State for Youth and by Public Affairs Branch of Employment and Immigration Canada
- connections to libraries worldwide; a database of over 350 scientists, engineers, technicians and technologists willing to interact with classrooms through e-mail from around the world
- access to a wealth of government information
- national press classroom edition news feeds; and on-line support and troubleshooting.

The key question for K-12 educators

What is the significance of all this capability? What does it mean to K-12 education? These and many other questions can be amalgamated into one key question. If an information utility such as Internet becomes as commonplace as other essential utilities, what are the implications of being able to travel the electronic highways for teachers, students and school administrators in Saskatchewan schools?

The Internet expands classroom resources dramatically by making many resources from all over the world available to students, teachers, and media specialists, including original source materials. It brings information, data, images, and even computer software into the classroom from places otherwise impossible to reach, and it does this almost instantly. Access to these resources can yield individual and group projects, collaboration, curriculum materials, and idea sharing not found in schools without Internet access.

Internet access also makes possible contact with people all over the world, bringing into the classroom experts in every content area, new and old friends, and colleagues in education. With an Internet connection, your site can become a valuable source of information as well. The isolation inherent in the teaching profession is well-known among educators. By having access to colleagues in other parts of the world, as well as to those who work outside of classrooms, educators able to reach the Internet are not as isolated.

The use of networks can be a motivator for students. The use of networks encourages the kind of independence and autonomy that many educators agree is important for students to achieve in their learning process. Because the Internet is blind to class, race, ability, and disability, it is a natural for addressing the needs of all students; exactly how this is done will vary from school to school as the school empowers the individual. For example, a report by the FredMail Foundation shows what often happens when students begin to consider issues that are of global concern.

The increasing volume and types of information available in electronic form, increasing resource sharing & networking ability, and increasing attention to accountability and productivity are three themes that recur frequently in the current literature (Marchionini, 1991). The "Information Highway" has captured the imagination of the popular media. Hardly a day goes by without mention of it somewhere. The term has been used so often, for so many pur-

poses, that it has lost most of its meaning. It can however, be defined in terms that have already been used in this report. Most of the talk about the Information Highway centers around increasing the carrying capacity of the backbones, and widening the reach of many regional and local networks. The result will be an increase in the volume and variety of information available to most citizens.

Like information in print form, the volume of information stored in electronic form is increasing daily. Networks simply provide a convenient way to access reports on educational research, curriculum guides, lesson plans, and lesson activities and subject related content. For example, Michael Hart, writing in the 1992 Project Gutenberg Newsletter, said that the goal of this project was to give away one trillion E-texts by December 31, 2001. "We should be at about 2.6 billion ... not counting pre-1991 releases: which are still in the process of being dug out of our archives, new headers attached, and new placement in new directories on our file server."

The collaborative communication capabilities of bulletin boards and networks can bring new life to discussions, report writing and projects because they can involve interaction with peers and colleagues from around the world (Weir, 1992). Discussion centers and teacher forums are available on a wide range of topics, including school-based management, alternative assessment, and equity and education issues. Telecommunications can enhance the range and scope of what students learn in the classroom. With the aid of creative teachers, students are using telecommunications systems to gather and exchange scientific data, to carry out creative writing projects, and to exchange cultural and social information (Riel, 1987).

Anecdotal reports have long suggested that collaborations that take place over telecommunications networks help to ease experiences of professional isolation common among teachers. Harasim and Johnson have observed that "... there is not a strong context of collegial exchange among teachers. This has a major impact on how teachers relate to their profession, to the quality of their working life, and to the adoption of change. Without access to support systems and to a context of collective reflection and analysis about the adoption and implementation of change (such as introducing computers into the classroom), stress levels are high, and teacher attitudes and morale are critically affected ... given these (and other) conditions, change can be a two-edged sword - either aggra-

vaiing teachers' problems or offering some means of resolving them" (Harasim and Johnson 1986, p. 21).

While there are may professional activities that one may engage in over the network, "... underlying all of these disparate activities, though, is the activity of building and maintaining professional relationships. All of the capacity and velocity of electronic communication is wasted unless we use it to seek out, cultivate, and nurture relationships with other human beings" (Agre, 1994). A community is made of people, not computers. Communities hold together because of the relationships that are established, not because of the technology. The technology however, can make it possible for like-minded persons to establish professional relationships independent of the barrier of distance.

Mason (1989) suggests that educators do not use networks very often and when they do, they often do not know how to use the technology for teaching purposes. "Connecting schools via e-mail, or accessing educational databases without strong foundations in the curriculum, can prove to be a technical hassle with very little educational benefit. The identification of what types of teaching and learning electronic communication is best suited for, what areas of the curriculum it best serves, and how best to integrate it with other educational media - these are the kinds of questions which must be answered before networking will be adopted by a significant number of educationalists" (Mason, 1989, p. 25).

In the GEM Project, which involved linking students within this country with their peers in other countries, Morton et al., (1989) reported that: "Telecommunications alone does little to enhance learning. Results of our work to date is very clear on this. International telecommunications as grandiose pen-pal projects is not part of our plan. Examples of programs of this kind show early disillusionment, half-hearted participation and eventual collapse; students' interests in their foreign peers' habits quickly wane. Educational telecommunications without structure and without instructional relevance in the operational learning milieu lose teacher and administrator support and quickly dissipate and disappear. Structured, planned, and carefully designed programs with local participation in the development process are critical to success where success is measured by learning gains and by expanded global cooperation" (Morton et al., 1989, p. 127).

The electronic highway is really just a collection of computers that have been connected together. Using the network, may K-12 students have participated in projects such as the National Geographic Kids Network Project (Weir, 1992); the FrEdMail Project (Rogers, 1990). Each of these projects, in its own way, has demonstrated the capacity to make remotely located learning resources available in the classroom. "In a small but significant way these projects and many more have been able to demonstrate the movement of "educational practice from didactic, classroom-based instruction to problem-solving based student generated learning in open classrooms across the world" (Morton, et. al, 1989, p.126).

Discussion

Industry Minister John Manley (1994) in his discussion paper suggests that government leadership is required to develop and implement a national network strategy. "The strategy will be made in Canada, by Canadians, for Canadians. It will be consistent with our regulatory history, our economic realities, our market size, our industry structures, the international context and our unique cultural and sovereignty requirements. Recognizing the economic, cultural and social implications of the information highway, the government proposes three objectives to be pursued by the strategy: create jobs through innovation and investment, reinforce Canadian sovereignty and cultural identity, ensure universal access at reasonable cost.

It is more realistic to associate sovereignty with geographic location than the transportation, entertainment or communications systems. Aircraft, motion pictures and network communication, by the very purposes they serve, recognize primarily only the limitations of the technology. Aircraft can land anywhere in the world that there is an appropriate runway and refueling facilities. Similarly, as audio, video and computer technologies continue to merge and cross-border contacts continue to grow, keeping Canada for Canadians and Canadians in Canada will be increasingly difficult and perhaps even undesirable if full benefits are to be derived from the system. As Nicholas Negroponte is reported to have said in a recent interview, the wired world is inherently international (Chevreau, 1994).

In the 1980's, videotex and Telidon two-way communications systems were often referred to as the information systems of the future. Internet and Telidon have much in common when it comes to transmitting pictures and sound. Today, few references, except

in a historical context, are made to Telidon. Will Internet be similarly referred to in the next decade? With the development of cellular telephone technology, how many trucks, recreational vehicles and automobiles are still equipped with CB radios? If the transmission of pictures, sound and text were the only capabilities of the Internet, then it would most likely have the same fate as Telidon.

The difference is twofold. First, the interactive component supplied by the computer and the use of telephone technology and second, a recognition that experts, anywhere in the world, are accessible and approachable.. A significant number of people have access to libraries and know how to acquire information from them. Anyone who has access to a computer, modem and telephone can readily transfer these skills to network sites and use the technology to locate and acquire library resources. The conversion of information, i.e.. sound, pictures, text or numbers, into digital form and the development of compression algorithms and switching techniques allows these resources to be communicated at high speed over a wide variety of networks. If the user has difficulty understanding or using the resources, then the same network that has been used to locate and acquire the resource can be used to broadcast a world wide request for help. The most valuable resource is the human that answers this request.

These trends have accelerated both the demand for and the pace of introduction of new products and services. They have also stimulated the demand for broad band networks capable of transmitting high-quality voice, video and data. (Manley, 1994) If this trend continues, the problem will not be access to information but rather a problem of finding resources that will be of value to the user at the time they are required by the user. It is easy to be seduced into thinking that there is magic inherent in the technology. The magic is not in the box but rather in the effective and efficient use the technology to acquire information and consult with peers, colleagues and experts in the field.

Who decides who will have access?

"Beyond the technical questions are social, political and economic issues. If we live in an information age, are we laying the seeds for a new information underclass, unable to compete with those fortunate enough to have the money and skills needed to manipulate new communications channels? Who, in fact, decides who has access to what? As more companies realize the potential profits to

be made in the new information infrastructure, what happens to such systems as Usenet, possibly the world's first successful bulletin board system, where everybody can say whatever they want?" (Griffin, 1993).

Are there professional development requirements?

Getting connected to the Internet network is the easiest and least expensive part of the task. There is still much support and training work left to be done. Internet tools already available like Archie, Gopher, WAIS and the World Wide Web, seem to be a good first step in solving the "information overload" problem. With 6-10 Terabytes of information to choose from, learning how to use these kinds of tools is essential and will continue to be essential as the Internet continues to grow at its current explosive rate (Cozzoline and Pierce, 1993).

Any plan for implementing technology in schools should consider staff development. In the case of the Internet, all users will need some kind of training, whether they are teachers, librarians, students, administrators, or fulfilling other roles in the school. Depending on the hardware involved, there may be a need for technical support. Finding this kind of support, which schools will certainly need because it is not usually in place, may not be easy. Some schools are able to use volunteers from business, industry, or government agencies. Once an Internet connection has been established, much of this type of support can be done over the network itself.

Providing funds for connecting schools together does not address the larger question of how teachers are going to learn to use this new resource. Teachers require training in using the equipment and implementing the technology into their classrooms. If teachers are not comfortable in navigating the networks, it is not likely that access to the network will do much to improve classroom learning environments. "Schools must get involved in training teachers in the use of telecommunications. At a minimum, the same level of investment that schools have made in computer-based training needs to be present for training teachers in the use of telecommunications." (Honey and Henriquez, 1993) Some states in the US. are beginning to take this idea seriously. Nebraska for example, has a new state law that empowers regional Educational Service Units to levy taxes to provide Internet access and training to all K-12 schools in the state. Training of their 20,000 teachers began before the 1993-94 school year (Pawloski, 1994).

Over time, a major investment will be required to provide the infrastructure, i.e.. network connections and phone lines to support the information utility just as major investments have been made in textbooks and other learning resources in the past. Computer hardware in the form of computers will probably be much like current student notebooks. When manufacturers learn how to make cheap display screens, the cost of computers will diminish to the point where, like calculators, every student who wants one will have one. "Expect to see 486-based PCs with CD-ROM drives selling for less than $1,000 in mass-merchandise outlets by year-end, and PDA prices dropping to $1,200 by 1995." (Bottom Line Personal 6/15/94 p.6) However, just as we have many cars and light truck on the roadways, there is still be a need for buses and 18 wheelers. Similarly, schools and other organizations will need a few larger computers to handle the tasks that are too large or require more processing power than the notebook machines can manage.

How do teachers acquire functional skills?

A user development model was first articulated by Hiltz and Turoff in their 1977 "Network Nation" study. Their model was then adapted by Hughes in 1992. It is Hughes' adaptation of the Hiltz and Turoff model that has served the purpose of focusing attention on the professional development needs of teachers.

Stage 1 is the 'uncertainty' phase. The uncertainty phase is where new users will only attempt to go on-line three or four times, and if not successful by then, will tend not to try again. This puts the burden on the project managers, to help novices experience success early in the network exploration activities. New users will rarely blame the 'system' but, are more likely to blame themselves for not having aptitude for such technical devices. The negative effects of the uncertainty phase will be reduced by the selection of technologically-experienced enthusiasts as early participants.

Stage 2 is the 'insight' phase where a novice user suddenly grasps the power and potential of telecommunications, and commits to learning how to do it. A higher level of user-unfriendliness and frustration is tolerable. This is also the self-deception phase. The convert, having 'seen the light', ascribes a sort of magical, problem-solving property to the on-line world and can't understand why others, who have not directly experienced the medium, are not as enthusiastic as they are about the network. Such converts are often shunned by their peers for being such an unbalanced advocate of the medium.

Stage 3, is the 'routine' phase. By now the end users are able to do what they came on-line to do and use the system as a practical utility. The honeymoon is over, but more work gets done. Use of ordinary administrative e-mail systems, business persons getting daily stock reports, teachers posting grades to a network, are characteristic of this phase. There is little excitement of learning, or of discovery (and one tends to forget what they went through to get where they are, and that others following them will go through Stages 1 and 2).

Stage 4, reflects the 'rising electronic expectations' phase. Not everyone goes to this level. It is where the user, having gone through the first three phases, and having internalized the process, and can use the telecommunications service for doing work in their field in a traditional way, (e-mail being just another form of surface mail) begins to realize that the systems they are using are 'just' computers, can be programmed to do many things they are not now doing - and begins to use their imaginations and say "Well if it can do that, why can't it do this - which is what I want."

As needs change, technology improves, and costs decrease, Internet will likely continue to evolve and become more popular among all segments of the academic community. In a society that is constantly moving toward an information-based economy, it is important that K-12 users participate in the process and have some influence on this evolution.

Are there requirements for technical support?

Technical support is essential to the success of projects involving computers (Gallo, 1993). A parallel in the business world is IBM. IBM grew to be a successful company not because they have sold the best computers in the world, but because they offered service and support to their customers. Teachers who teach full time and take on the task of managing a local network are destined to fail or die prematurely. Although not yet readily recognized by school system administrators and trustees, human support for computer systems needs to be thought of in the same way as human support for mainstreamed students. While provision has been made for the often time-consuming task of taking proper care of special-needs students, the time-consuming task of managing computers and/or computer networks is often seen as an add-on task for an already very busy staff member. Technical support for hardware, software and system users is an on-going requirement and a necessary prerequisite for the successful integration of any form of technology into the classroom.

Does Internet have navigational aids?

The Internet has grown and evolved without any regulation. It continues to grow and change at breathtaking speed. Navigating through this community is a genuine challenge. Fortunately, there are some software assistants available. For example, Hytelnet is a tool that has been designed to assist users in connecting to all of the Internet-accessible libraries, Free-nets, CWISs, BBSs, & other information sites by Telnet. Menu choices play a major role in making access to services easy for the user. It is useful to all users who can access the library via a modem, serial line, or direct network connection.

Gopher provides user-friendly access to a world/campus-wide information system. While providing a delivery vehicle for local information, Gopher facilitates access to other Gopher and information servers throughout the world. The problem of finding useful things on the network has been reduced to making appropriate menu selections. The system is smart enough to do all the busy-work of entering the codes necessary to connect the computers together. In this way, novice users can virtually ignore all the technical detail and concentrate on making content decisions.

Lynx and Mosaic are recently developed user-friendly front ends to Internet tools and services. The WorldWideWeb (W3) is the universe of network-accessible information, an embodiment of human knowledge. The W3 model is presented to the user as a hypertext or hypermedia object. There two navigation operations are available to the user: to follow a link or to send a query to a server. Almost all other information systems can be represented in terms of W3 documents. A W3 user can interrogate WAIS indexes and Gopher servers. This comes from the flexibility of the W3 model to describe other structures. A WAIS database is a searchable document. The hit-list returned by a WAIS server (or any other query engine) is a hypertext document with links to the documents found. Gopher menus (or any other hierarchical menu system, including a file system) are represented as lists of items linked to other objects. The W3 system has an open addressing scheme allowing links to be made to any objects on W3, WAIS, Gopher, FTP, NFS, or Network News servers.

Are there enough telephone lines?

Phone lines need to become much more widely available in schools. Teachers are the only group of professionals who do not have regular access to telephones, often because the cost of installing phone lines in school buildings is prohibitive. Ideally, regional

phone companies need to develop pricing structures that encourage schools to invest in this technology for their teachers. Alternatively, schools can also consider installing local area networks—a solution that reduces the need for multiple phone lines in school buildings (Newman, Bernstein, & Reese,1992).

Can the network cope with the increasing traffic?

One dominant theme keeps recurring - and that is that all K-12 should be connected to the Internet. Directly. And nothing less than that will do. (Hughs, 1991) However, in the real world of thousands of schools, hundreds of thousands of teachers and millions of students, getting on line only solves about a quarter of the problem. In time, with all types of users competing for a limited number of access ports, getting on-line may be the problem. Second, video and sound files are large files. Larger files take more time to transmit and receive. Large numbers of users, with large files all competing for the same space may result in an electronic traffic jam analogous to a traffic tie-up on a traditional highway.

Is the capability of the hardware sufficient?

A computer, modem and software capable of some type of terminal emulation is all that is required to get started sending and receiving text files. Larger tasks like sending and receiving sound or graphics files will require a computer with several megabytes of RAM memory, a large hard drive and a fast modem (14.4k) For very large tasks, direct connection to an ethernet network is essential.

Will students have access to materials unsuitable for the classroom?

Yes, like other forms of publishing, material that appears on the network may be judged as pornographic by some users. A system administrator's attempt to disable access to questionable materials will likely fail because intelligent users will find creative ways to access sites that do store and make available the desired materials. Second, in the minds of some users, making such material a "forbidden fruit" frequently enhances their desirability. If student access to pornographic materials becomes a problem, then one approach that is more likely to be successful is to turn the situation around and use the opportunity to engage in the process of teaching about the ethics and appropriateness of using this kind of resource in a school setting.

Where will teachers find the time to use the network?

Teachers needed time for studying the technology, planning for its use and integrating the technology into their lives or their classrooms. Lack of teacher time was considered a very strong barrier to the successful implementation of many telecommunications projects. "Research on technology integration efforts shows that

typical 40-minute class periods are not adequate for projects that successfully integrate computer or multimedia technology into the curriculum." (Sheingold & Hadley,1990).

What about student assessment?

Two or three times every year, teachers are faced with the real life necessity of reporting to parents. In order for teachers to feel confident that student-based telecommunications projects are academically justified, assessment measures must be devised that can adequately capture and account for the kinds of critical thinking and inquiry-based analytical skills that such activities appear to foster. (Honey and Henriquez, 1993) Much of the literature has focused on the benefits of network and the problems associated with navigation in a sea of information. Issues related to student assessment are topics that will have to be addressed in some detail.

Conclusions & Recommendations

Providing network access has become a government priority in Canada and several other countries. Information equity for teachers at all levels has been used as part of the justification for the development of the communications infrastructure. The expanding capabilities of libraries to deliver sound, graphics and video as well as text resources over the network has the potential to change the way we think of resource centers in school libraries. Because of increasing transmission speeds and network efficiency, small schools with limited resources will now have the same access to learning resources as larger, more well established institutions. For this reason alone, the technology will eventually diffuse through the system.

Like computers, computer networks are tools. They are not a solutions to problems, either real or imagined, at any level of the educational system. Instead, networks make it possible for students and teachers around the world to use an increasingly available technology to engage in projects that change routine tasks such as writing papers and engaging in discussion into exciting, collaborative learning activities. The communications capability of the network seems to capture and maintain students' interest in academic activities. The motivational aspects of the network and its ability to help students achieve a more global understanding of issues and events make access to the network a worthwhile undertaking. There is widespread agreement that telecommunications can enhance the range and scope of what students learn in the classroom (Ruopp, 1993).

Recommendation # 1

Given the rapid development of network communications and its potential impact on the classroom, all schools in the province should be encouraged to develop an action plan to acquire access to this utility.

A portion of the literature and many media reports have focused on glitzy elements of the network such as the speed of transmission and the variety of resources that are available. Realistically, finding the resources you want when you want them is often more likely equated to searching for diamonds in a gravel pit than accidentally discovering the mother lode. There are few standards on the Internet, indexing systems are primitive and access to host sites is often unstable. Frequent network users must develop a high tolerance for ambiguity. However in a world of increasing complexity, rapid change and knowledge accumulation, well developed information processing skills are essential to the well-being of every member of the global community. The crude and often unrefined network access utilities make the network an excellent training ground for the development and refinement of information processing skills. Well-developed information processing skills are essential to being able to cope with the increasing capability of systems to overload the user with non-essential information.

Recommendation # 2

Given that well developed information processing and problem-solving skills are essential to the development of independent learners, all schools in the province should be encouraged to integrate the use of the network and the evaluation of network resources into regular courses of instruction.

Support for professional development activities is essential, especially for novices users who may suffer from some degree of technophobia. " ... teachers do not have time to mess around with baroque configurations that break down, take time, and demand attention that detracts from their educational usefulness" (Weir, 1992, p.18). Every new service on the system increases the workload of technical support personnel. Providing support to end users when they are first learning how to use the system is a good investment because informed computer users are better able to solve some of their own problems and in this way reduce the demands on the time of central consultants. Second, networks and network users have developed their own language. To expect a classroom teacher who is unconversant in the language of Internet

to be able to integrate network resources into instruction without some preparatory training is equivalent to asking an automobile service technician who is used to working with carbureted fuel systems to now service fuel injected systems. It can be done, but not without wasting a significant amount of time and human resources. Training is critical to the success of telecommunications-based projects (Teles and Duxbury, 1991).

Recommendation # 3

Given the complexity of the technology and the extensive teaching responsibilities of most teachers, all schools in the province who make the decision to have Internet resources made available in their schools should also be encouraged to provide human resources to maintain the system and give the necessary technical support to both teachers and students.

Three to six years elapse between the time an author starts to write a textbook and the time it is ready for student use. In some areas of study such as the humanities, the time delay between book production and book utilization may not be a major factor limiting its usefulness. In the sciences however, the lack of currency may be a limiting factor. For example, new products, techniques and knowledge are rapidly being created as a direct result or spin-off from the NASA space programs. Network access to NASA resources can be used to compensate for the lack of currency in science textbooks. Similarly, network available CNN lesson plans correlated with daily television news broadcasts helps to keep current events current, in context and readily accessible.

Recommendation # 4

Given the rapid obsolescence of some textbook resources, all schools in the province should be encouraged to use Internet resources to update aging materials and broaden the availability of unique resources through the use of electronically available, public domain texts.

Keyboarding, word processing, and other computer applications monopolize nearly all of the available lab based computing resources in our schools. As a result, only a few teachers are able to exploit the computer skills of their students to support content area learning because of the limited access to the computer labs. As a result, they are not in a position to make significant changes to their curriculum that will permit students to benefit from technology. Hence, it is often difficult to see any direct impact of the technology in the classroom. In this context, access to the network

and the equipment to travel the electronic highways are important components in the integration formula, but an equally important factor is time commitment. Teachers who don't have computers in their classrooms and who are tied to a rigid time table are unlikely to be able to physically find the time to integrate much technology into their instruction. When print technology emerged it changed both the time frame and the manner in which instruction was delivered. While it is a natural response to try to manage a new technology with old methods, it is just a matter of time until sufficient pressure builds up to promote change in the delivery of instruction. Integration shows that typical 40-minute class periods are not adequate for projects that successfully integrate computer or multimedia technology into the curriculum (Sheingold & Hadley,1990).

Recommendation # 5

Given that computers placed in lab settings tend to perpetuate translation of paper-based methods of instruction to computer based methods, all schools in the province should be encouraged to use computer labs as a transition phase and move toward providing network accessible computers in classrooms.

Summary

This report has been prepared with the intent of looking at the context and the impact on the classroom of teacher and student access to the Internet. Internet is a collection of computer networks linked together for the purposes of providing ready access to digital resources and communications utilities. Internet services are available from commercial and non-commercial providers. Like other utilities, these services cost money to provide. The main difference between commercial and non-commercial services is who bears the cost. While chat channels, news groups and electronic mail are currently the most popular services, the distribution of sound, graphic and video library resources is increasing daily. As network capacity increases and user access rises, there is no doubt that the electronic distribution of learning resources will also increase. Ultimately this will have a profound effect on all forms of publishing activities. Traditional libraries and learning resource centers will no longer have a monopoly on the storage of accumulated knowledge.

Access to information is no panacea. The larger the information pool, the more refined individual information processing skills have to be because the current indexing systems and retrieval tools are limited and primitive. However, user-friendly interfaces such

as Mosaic are beginning to address this problem. While teachers may be the only group of professionals who have computers on their desks before they have telephones in their classrooms, access to learning resources via cable and/or telephone systems is imminent. The real challenge for educational systems is to determine how to help all members of the educational community learn how to take advantage of the positive attributes of this new transmission technology. Translating what we have done in the past into a form in which we are able to do it better and faster will not remain a credible way to carry out educational activities for very long. The time for serious exploration and experimentation with new ways of integrating current technology into classrooms and sharing both the successes and failures of doing so with a global community has arrived. The challenge for all partners in our system of education is to find efficient and cost effective ways to bridge the ever increasing gap between the way in which we are used to locating, accessing and using information and the way in which we will engage in this process in the next century and well beyond.

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